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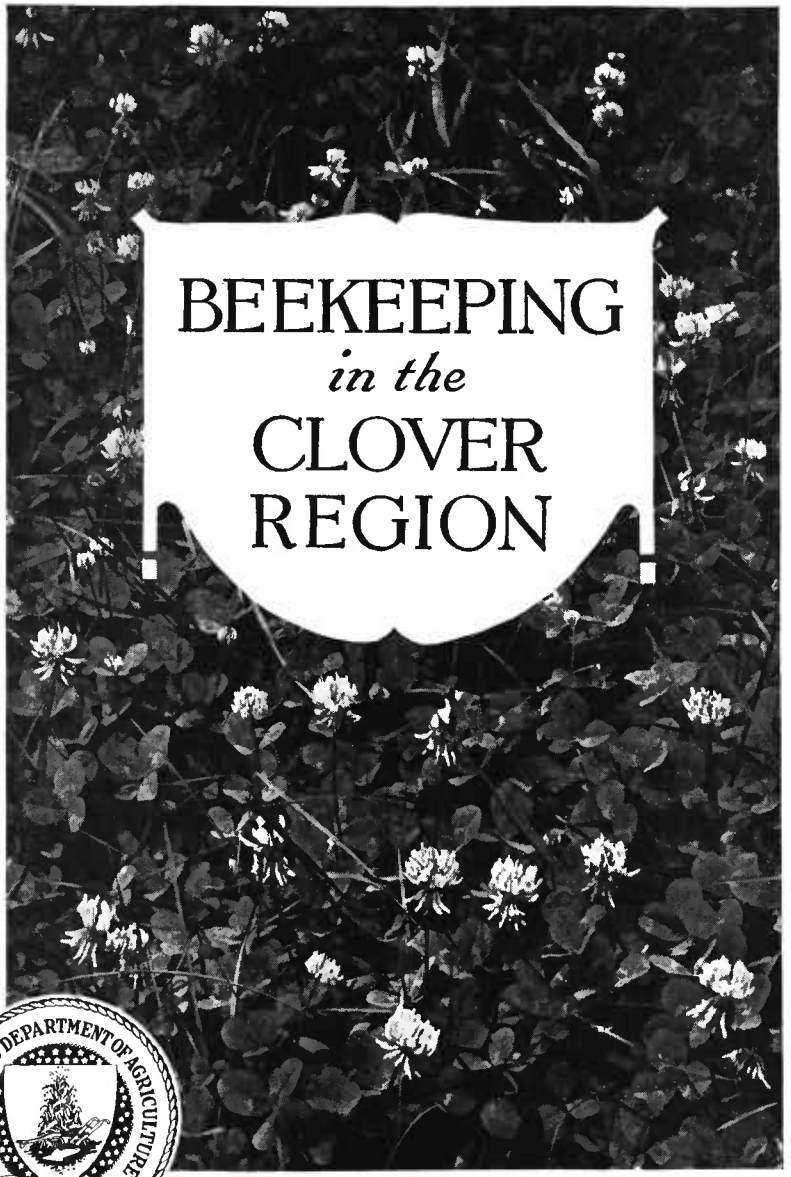

BEEKEEPING *in the* CLOVER REGION

BEEKEEPING METHODS suitable for the clover region are well developed but many beekeepers of this region are failing to obtain the full available honey crop because of deficiencies in their practice. A system of management is here given which will result in a full crop from these sources.

The variation in the value of the clovers to the beekeeper is also discussed and the methods to be followed in bringing the clover region back to its former prominence in honey production are outlined.

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BEEKEEPING IN THE CLOVER REGION

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CONTENTS.

BEEKEEPING practices in the United States have been developed largely in the clover region and because of this the literature of the subject deals chiefly with methods applicable to this territory. Nevertheless the clover region is failing to produce the honey it should; chiefly, no doubt, because the methods that give the best results for the region are not clearly analyzed, and there are so many to choose from that the beekeeper can with difficulty decide which are best. Clover is now the source of a vast amount of honey, doubtless furnishing more than any other nectar-secreting plant. Since the honey from this source is not surpassed in quality by any other, it is important to the beekeeping industry that the clovers be utilized more completely. This bulletin endeavors to simplify the problem of the beekeeper of this region by describing those practices which have been proved most effective. A single system is here outlined, rather than several methods for each phase of the work, the plans given being those which will give the best results in most clover locations.

The clovers included in this discussion are *white clover*,[1] *alsike clover*,[2] and *red clover*.[3] These plants bloom at nearly the same time, the honeys are almost identical, and the same methods may be used for the gathering of their honey crops. Their geographical distribution in the United States may be considered, for the purposes of this bulletin, as identical. These clovers belong to the family Leguminosae, to which belong many other important honey plants, such as alfalfa[4] and sweet clover.[5]

[1] *Trifolium repens.* [2] *T. hybridum.* [3] *T. pratense.* [4] *Medicago sativa.* [5] *Melilotus alba.*

GEOGRAPHICAL BOUNDARIES OF THE CLOVER REGION.

The typical clover region occupies the northeastern part of the United States, extending west into Minnesota and south approximately to the Ohio River and Mason and Dixon's Line. It appears on the west coast in Washington and Oregon. In both east and west the region extends into Canada, some of the best portions being located north of the national boundary. Limited areas of less value are found outside the boundaries indicated.

It must not be assumed, however, that these plants are equally valuable to the beekeeper throughout the area indicated; for, as

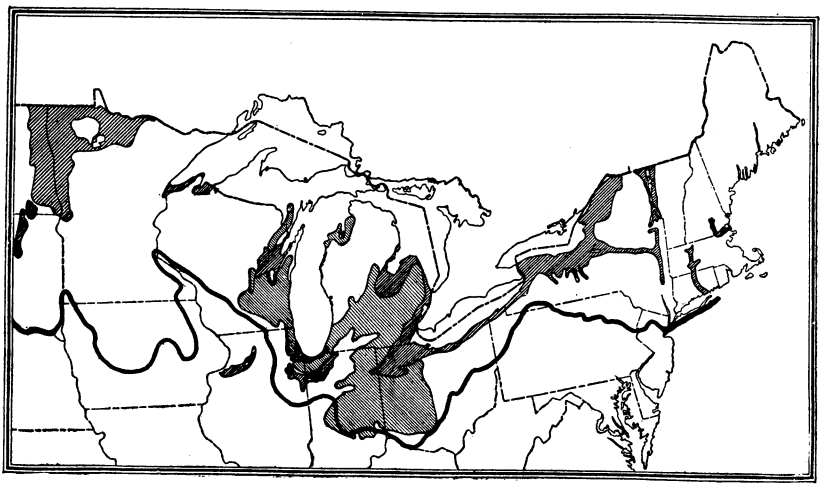

FIG. 1.—Map of clover region showing boundary (heavy black line) of area covered by the last glacier. The best areas for nectar secretion from the clovers are those formerly covered by glacial lakes (shaded from right to left), when properly drained, and those of the Middle West (shaded from left to right), where the soils are derived by glacial action from rocks containing limestone. Undrained swamps are useless as clover areas.

will be pointed out later, nectar secretion of these species is influenced by many factors, and as a result there are many places in the area here indicated in which the plants are almost valueless for nectar secretion. In general, the farther north one goes the better the secretion becomes from these species. Most of the best clover territory lies in the area covered by the last glacier (fig. 1) and the best of the clover region lies in western Vermont, northern and central New York, northwestern Ohio, northern Indiana, and Illinois, Michigan, Wisconsin, Minnesota, and northeastern Iowa. While these clovers are found in all parts of the United States, except in the arid regions, the beekeeper outside the best areas may not look to them as sources of nectar, except possibly as minor contributing sources. The discussion in this bulletin is applicable only to those places where they are major sources of honey.

VARIATIONS WITHIN THE REGION.

As has been indicated, there is great variation in the frequency of occurrence of the plants in the region included in the geographical boundaries of these clovers. There is also, as is well known to beekeepers, an enormous variation in the amount of nectar secreted by these plants according to soils, climatic conditions, and other environmental factors, to be discussed briefly further on. The color of the nectar, and of the resulting honey, varies considerably, the honey being darker where the secretion is less rapid. In general, it may be stated that secretion is most abundant, and the honey of the best quality, where the soils are not acid (fig. 1) and where the summer temperatures are relatively low (fig. 2).

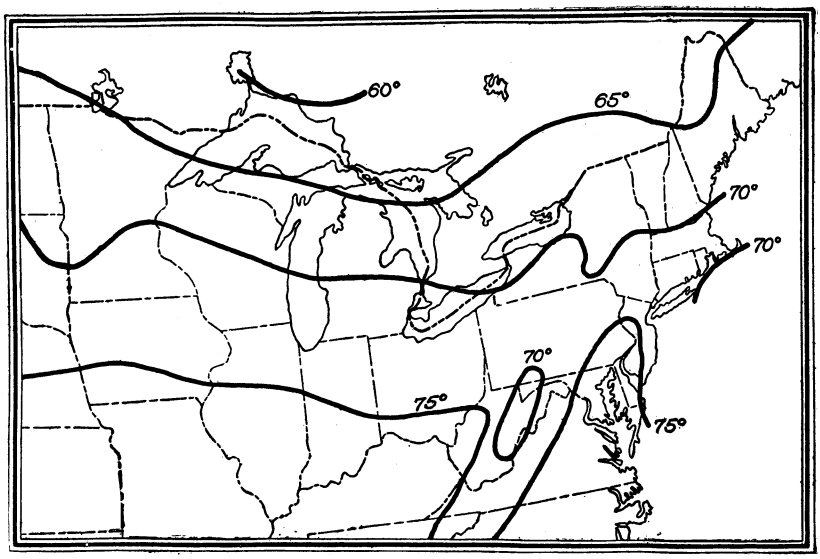

FIG. 2.—Normal July temperatures in clover region. Because of variation in the time of blooming of the clovers this map may not indicate the normal temperature at the blooming season for the southern part of the region. The optimum normal temperature for nectar secretion from the clovers is about 70° F. or less.

Unfortunately, the statistics of beekeeping are not sufficiently accurate to enable one to mark definitely the boundaries of the best of the clover region, nor are data available from other sources which may be used without reservation as indicative of the optimum conditions for nectar secretion of these plants within the region. In general, any region suitable for a high development of dairying is one where heavy nectar secretion from the clovers may be expected.

RELATION TO OTHER BEEKEEPING REGIONS.

Within the broad boundary of the clover region are included many other beekeeping regions of lesser extent, such as the buckwheat region. The presence of other plants on which the beekeeper depends for surplus honey naturally modifies materially the methods of beekeeping practiced; but, since there are within this region no

other important nectar-secreting species which bloom earlier than do the clovers, the beekeeper must plan his work so as to get the greatest possible amount of honey from this source. Where buckwheat is a major source of honey the clovers are not at their best. Where tulip tree is a major source of honey the clovers are usually insignificant. The clover region does not extend westward into the territory where alfalfa becomes a major honey source. While there is considerable sweet clover within the clover region, this species is more important to the beekeeper outside the area where the other clovers are important.

It should be emphasized that, since the clovers do not secrete nectar freely everywhere within the area indicated, there are minor areas within the clover region where other species are the main dependence of the beekeeper, and these areas are not to be considered as part of the clover region in a strict sense. Examples of this are to be found in the willowherb and wild red-raspberry regions of the North and, especially, the swamp regions, such as those in which Spanish needle is a major source.

CHARACTERISTICS OF THE CLOVERS.

WHITE CLOVER.

White clover is a native of the Old World and is not thought to be native to North America. It is a perennial, low-growing, creeping plant, propagated by seed and also taking root on the creeping stems. The roots are shallow and do not arise from a crown. The stems are recumbent. The flowers are white, with a slight pink tint on the tips of the corolla at times. To the northward this pink tint increases in extent and intensity, and at high altitudes the flowers of this species are decidedly reddish. As the flowers of the head wither the petioles are no longer erect and the individual flowers turn reddish-brown and bend backward around the stem. The leaflets are smaller and more rounded than those of alsike clover and have light markings, similar to those of red clover.

The chief blooming period, and the only one which may be counted upon to furnish nectar, begins about five to six weeks after the average date of the last killing frost in the spring (fig. 3), and lasts about three to five weeks. Some blossoms appear before the date indicated and it usually happens that nectar secretion does not begin until 10 days after the first blossoms appear. Under favorable weather conditions the blooming period may be greatly prolonged, and sometimes the period of nectar secretion is also lengthened, although usually flowers blooming in the later part of the summer furnish little or no nectar. The chief agent for pollination of this species is the honeybee.

As has been indicated, nectar secretion is not uniform throughout the range of this species. The plants thrive best when there are good rains in July, August, and September. Winterkilling is less noticeable for white clover than for red clover. If there are abundant rains in May the plants are put into a condition of great vigor, and this adds greatly to the probability of a heavy secretion for the season. Rains while the plants are in bloom serve to prolong the period of blooming and of nectar secretion. White clover is seem-

ingly most valuable as a honey-source in the northern part of its range, and this is probably due to the fact that the plants are most vigorous and secrete nectar most freely where the temperatures at blooming time are relatively low (fig. 2). The species is able to reseed itself in central Alaska, where the growing season is exceedingly short. It is recorded that secretion occurs in the north at temperatures too low for bees to fly. It rarely may be counted upon as a major honey-source where the average summer temperature exceeds 75° F. A more important consideration, however, is that secretion is most rapid where there is a considerable daily range of temperature, the best results being observed when the night temperature is below 65° F. and the day temperature above that point.

FIG. 3.—Map showing average date of last killing frost in spring. From these data the beekeeper determines the time to unpack colonies of bees wintered outdoors.

While proper climatic conditions are necessary for nectar secretion from this species, it is only where soil conditions are favorable for the growth of the plants that the beekeeper can expect to get a heavy secretion of nectar. (Fig. 1.) Soils having an abundance of lime are found wherever white clover is a major source of honey. While white clover plants are observed growing in soils that are deficient in lime, under such conditions these plants secrete nectar only under the most favorable climatic conditions, and failures in the clover-honey crop are frequent in such regions.

ALSIKE CLOVER.

Alsike clover also is a native of the Old World and is not native to America. In ordinary farm practice it is grown as a biennial, although a few plants may survive after seed production. It is propagated by seed and not from creeping stems. The roots are shallow and branching. The stem is erect and rarely exceeds a

height of 2 feet, except on low, rich land or in the far north. The flowers are white to pinkish-rose, the color being deeper to the northern part of the range. The flowers of this species turn back on maturing, as do those of white clover. The leaflets are shorter and relatively broader than are those of red clover. The heavy blooming period may begin slightly before that of white clover and is often curtailed by cutting. When the plants are pastured the blooming period may be prolonged if the climatic conditions are favorable. The chief agent for pollination is the honeybee.

In general, the conditions favorable for nectar secretion for alsike clover are the same as those for white clover. This species differs from white clover, however, in the fact that it is a regular farm crop in some places, and such locations are unusually favorable for the beekeeper. It is increasing as a farm crop, especially in locations where, because of increasing soil acidity, red clover is no longer so profitable. Alsike clover is grown alone and with timothy for hay, and in some limited localities it is grown for seed, thus giving the maximum time for nectar secretion. It does not yield nectar equally well in all places where it is grown for hay, since the best yields are possible only where the soil and climatic conditions are most favorable. In the northern part of the range of this species the nectar secretion is greatest.

RED CLOVER.

Red clover is a native of the Old World, having been cultivated as a farm crop for many centuries. It is a biennial, rarely perennial, propagated by seed. It has a branching taproot extending deep into the ground, the depth varying with the character of the soil. The stems are erect and vary in height, being higher than those of alsike clover. The flowers are bright red or purple, remaining erect after withering. The leaflets are larger than those of either of the other two clovers mentioned and have V-shaped lighter markings. In ordinary farm practice there are two separate blooming seasons, the first coinciding in time with that of alsike clover. When grazed the blooming season is extended until fall under favorable weather conditions. Unlike alsike clover, the usual farm practice is to cut the first crop for hay and then permit the plants to mature seed in the second crop. While because of the length of the corolla tube this species is best adapted for cross-pollination by bumblebees, no insect is of more importance in the setting of the seed than is the honeybee. When the mammoth red clover is grown the blooming season is prolonged, as this variety comes into bloom from one to two weeks later than the common red clover.

Because of the fact that the honeybee can not always reach the nectar in red clover, accurate data are unavilable as to the conditions best suited for nectar secretion in this species. In general, conditions favorable for nectar secretion in white and alsike clovers are also those under which red clover produces the most nectar. It is well known that the amount of nectar produced by the red-clover flowers is greater than that in the flowers of the other two clovers, and it is indeed unfortunate that the honeybee can not take full advantage of this abundant source. The beekeeper usually does not credit red clover with the production of much nectar available to the

honeybees, but it is doubtless true that where this species is grown it forms at least an important minor source of nectar, and probably much of the clover honey produced in the United States is partly derived from red clover. Usually the benefit from red clover is more noticeable from the second crop, it being believed that the shorter corolla tubes enable the honeybees to gather a larger proportion of the nectar. This is especially valuable to the beekeeper because at this time the secretion from white and alsike clovers has usually ceased.

Red clover does not thrive in wet or cold soils, to which alsike clover is better adapted. It is losing ground as a farm crop, probably because of an increasing deficiency of lime in the soils of the regions in which it was formerly more abundant. This is fortunate for the beekeeper, in that its place is being taken more and more by alsike clover, which is better adapted to visits of honeybees.

While there is a gradual shifting in agricultural importance of the various clovers, the beekeeper of the typical clover region has no cause for alarm, because more and more the farmers of this region are recognizing the necessity of growing crops which are capable of fixing nitrogen from the air, and so far no such crop has been found for this region which does not furnish abundant nectar.

PRESENT DEVELOPMENT OF BEEKEEPING IN THE REGION.

As has been indicated in an earlier section, beekeeping as a business first developed in the United States in the clover region. Because of the peculiarities of the problems of this region, and the difficulty of getting the maximum honey crop from the clovers, the most skilled beekeepers of the country are found in the clover districts. It does not necessarily follow, however, that the clover region is as well developed as it should be, for it is unfortunately true that too few of the beekeepers of this region are sufficiently skilled to make beekeeping a vocation. This region is the most densely populated part of the United States, and this leads to a larger number of amateur beekeepers.

There is not so much honey produced in the clover region to-day as formerly, and this decline is not due to any change in the value of the clovers as honey plants. Formerly basswood [6] was abundant throughout most of this region. It begins to bloom much later than the clovers, and when it was abundant the beekeeper could utilize part or most of the clover season to prepare his colonies for the basswood honey-flow to follow. The loss of the basswood made it necessary that the care of the colonies be improved if a surplus crop was to be obtained, and since many beekeepers were not able to do this, they suffered a decline of their business, while many abandoned beekeeping. The development of more intensive agriculture in much of this region reduced the abundance of the flowers which furnished the honey-flows of the fall, making it more difficult to devise a system of beekeeping which would insure good colonies for winter. The most important factor leading to the decline of beekeeping in this

[6] Linden, *Tilia americana.*

region was the methods which came into vogue during the days when comb honey was produced almost exclusively. At that time it was the aim of most beekeepers to have every possible drop of early honey stored in the supers, and this resulted in a shortage of honey for fall and winter, which in turn resulted in the death of many colonies or a great reduction in colony population the following year. It thus became common for beekeepers at that time to have exceedingly small colonies, and this reduced the profits of beekeeping so greatly that many persons no longer found it profitable to keep bees. It seems strange now that the cause of this decline was not then recognized, but with a return to more rational beekeeping methods it is found that the clover region has not lost its capabilities for profitable beekeeping, and it is now becoming again an important area for honey production. There is no part of the country where the industry may be carried on with greater profit than this, but if the most is to be made of the region highly skilled beekeeping is necessary.

Throughout much of this region there is no major honey-flow other than that from the clovers, and the beekeeper's entire return must be from this one source. This makes it necessary that every colony be in the best condition at the beginning of the clover honey-flow, and this is impossible for any but the best beekeepers. This region is therefore one especially well adapted to the development of beekeeping on a commercial scale, since only the skilled beekeeper can expect to succeed under these conditions.

PECULIARITIES OF THE REGION.

The uncertainty of a honey-flow in the fall in much of this region increases the difficulty of having the bees in proper condition for winter, and to an unusual degree increases the difficulty of having adequate stores in the hive for the winter, and especially for the brood-rearing period of the following spring. As the clover region is located in the north, the wintering problem is more intense here than in any other beekeeping section of the United States. This part of the work of the beekeeper has not received the attention which it demands, which largely explains the small colonies so frequently observed at the beginning of the clover honey-flow.

Coming as it does so soon after the average date of the last killing frost in the spring, the clover honey-flow is one which it is difficult for the beekeeper to utilize to the full extent. Furthermore, the secretion of nectar is quite rapid, making it necessary for the beekeeper to provide supers at just the right time and in sufficient number. Then, too, the honey-flow is frequently short in duration, so that the bees must be ready at the very beginning if a full crop is to be obtained.

Because of the character of the honey-flow and its time relation to the period of spring brood-rearing, swarming is more intense and more difficult to control than in any other region in the United States. While much work has been done on methods of swarm control applicable to this region, these methods are not understood by the majority of beekeepers and in good years it happens frequently that half the crop is lost through failure in this regard.

TYPE OF HONEY TO BE PRODUCED.

Since the passage of the Federal food and drugs act in 1906 the tendency in beekeeping has been more and more to produce extracted honey. Because of the rapidity of the clover honey-flow, and especially because of the superior quality of clover honey, this region is perhaps better adapted to the production of comb-honey than any other main region of the United States. Not all of the clover region is equally good for comb-honey production, however, for the production of good comb-honey necessitates rapid secretion of nectar. Where this occurs in the clover region, the honey is of the highest quality and the color is lighter than in other parts of the region. Clover honey is also favorable as a comb-honey type because it does not quickly granulate in the comb as do some of the other light-colored honeys of the country.

An additional reason for the production of comb-honey in the clover region is that the largest consuming population is in this region. The comb-honey producer of the clover region does not, therefore, have so far to ship his product—an advantage of importance in the shipping of so delicate a product. While the West and South can and will produce extracted honey in abundance in the future, it may happen that the future of the clover region lies in the development of still greater production of comb-honey. It should be pointed out, however, that comb-honey can not be produced successfully and profitably by careless beekeepers, and if this region is to increase in importance in the production of comb-honey it must be through the development of a larger number of skilled beekeepers within the region. Because of the difficulty of swarm control in outapiaries run for comb-honey, extracted honey production is more attractive to the specialist beekeeper so long as the returns per man are as great and so long as the sale of pure extracted honey is facilitated by the protection of pure-food laws.

OTHER PLANTS IN THE REGION WHICH FURNISH NECTAR.

Throughout the clover region there are other plants to which the beekeeper may look for additional honey, and within its boundaries are more restricted areas, usually marked off by soil or moisture differences, where other important major honey sources are found. Among these major honey sources may be mentioned wild red raspberry [7] and some of the members of the heath family, which bloom early in the summer, and willowherb,[8] milkweed,[9] Spanish needle,[10] sumac,[11] and buckwheat,[12] which bloom later. In some localities these plants are found quite near to good clover territory, but as a rule the places where these plants furnish considerable nectar are not those in which secretion from the clovers is good. They can be utilized by the beekeeper of the clover region best by the practice of migratory beekeeping.

There are still other plants which grow in the same type of locations in which the clovers thrive, and among these may be mentioned

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[7] *Rubus strigosus.*
[8] *Chamaenerion angustifolium.*
[9] *Asclepias* spp.
[10] *Bidens* spp.
[11] *Rhus* spp.
[12] *Fagopyrum esculentum.*

fruit bloom, dandelion,[13] the maples,[14] tulip-tree,[15] and black locust,[16] which bloom early, and basswood,[17] sweet clover,[18] and heartsease,[19] which bloom later.

The wild red raspberry, various members of the heath family, and willowherb thrive on acid soils of the North. The willowherb is common in northern Canada extending southward in burned-over areas on sandy and acid soils into Maine, New York, Michigan, and States westward, and appearing again in the United States on the west coast. Milkweed honey is produced in certain parts of Michigan. The species of Spanish needle valuable for nectar thrives in swampy locations, being most important in northwestern Indiana and in adjacent territory in Illinois, and it is found in other places outside the typical clover region. While buckwheat is grown in many parts of the clover region, it is most abundant and most beneficial to the beekeeper in the plateau region of New York and Pennsylvania, where the clovers are not at their best.

Basswood was formerly an important source of honey in the clover region, but it has been so largely removed that it is now less important, although in some seasons good yields are still obtained from this source. In fruit-growing regions nectar from fruit trees is an important source of early honey, but usually is not sufficient in amount to provide surplus honey. Tulip-tree is more southern in its main distribution, but in some parts of the clover region may furnish some early honey, provided the bees are in condition to get it. Sweet clover is found almost throughout the clover region in limited quantities. It is increasing in importance, but is more valuable as a honey-plant outside the typical clover territory. Heartsease thrives in the moist soils of river bottoms in the clover region, but is more important as a honey-source outside this region.

Since adequate preparation for the clover honey-flow brings the colonies to their full strength as soon as is practicable in the spring, no special modifications are called for in taking advantage of earlier sources. Within this region the later honey-flows usually follow almost immediately after the clover, and as a rule there is no late summer honey-flow. The later honey-flows are usually so irregular in this region that they do not constitute part of the beekeeper's regular program, and if he gets honey from them he considers it as something additional for which he has not had to plan. As one goes farther north in the clover region the probability of a continuous honey-flow during the summer becomes greater.

EQUIPMENT RECOMMENDED.

The hive generally used in the clover region is the 10-frame Langstroth, and all the practices described in this bulletin are based on the use of this hive, which is the standard for the United States. Hives having deeper frames or a larger brood-chamber may be used without great difference in the methods here described, but no hive smaller than the 10-frame Langstroth should be used in this region. This hive is not patented and is now sold by all the dealers in beekeeping supplies. Care should be exercised to get accurately made

[14] *Acer* spp. [15] *Liriodendron tulipifera.* [17] *Tilia americana.*
[13] *Leontodon* spp. [16] *Robinia pseudacacia.* [18] *Melilotus alba.*
[19] Smartweed, knotweed (*Persicaria* spp.; *Polygonum* spp.)

hives and frames. The spacing of the frames should be accurate and the parts of all the hives should be interchangeable.

The combs of the brood-chamber should be all of worker-sized cells. This may be obtained best by the use of full sheets of comb-foundation, and no beekeeper of this region can afford to use merely starters of foundation. The frames should be carefully wired to strengthen the combs. Even when full sheets of worker foundation are used, there will be a tendency for the foundation or the combs to sag, leaving several rows of imperfectly formed cells at the top of the frames. The beekeeper should constantly sort out imperfect combs and use them for the supers. Extra care should be exercised to see that only perfect combs are placed in the lower one of the two hive-bodies during the winter in order that the queen may pass easily from the second to the first story during the period of brood-rearing previous to the time of unpacking.

Because of the presence of European foulbrood in some parts of the clover region, and especially because of the superior quality of the Italian race of bees, the beekeeper of this region will find it greatly to his advantage to keep bees of this race. These bees are able, under good management, to clean out the larvæ dead of European foulbrood. Not all strains of this race are equally good for this purpose and the beekeeper should take pains to get those which are best. No one strain of Italian bees can be recommended as the best, and the proper plan for the beekeeper is to buy several untested queens from several reputable queen breeders who have been engaged in breeding queens for sufficient time to establish their reliability and ability to breed good stock. The names of breeders may be obtained from advertisements in the bee journals. From queens thus purchased there may be chosen the one or ones suitable for breeding purposes, and the beekeeper should then plan to raise his own queens from this stock. The time and methods of queen-rearing will be discussed further on.

ADAPTATIONS OF BEEKEEPING PRACTICE FOR THIS REGION.

Because of the peculiarities of the clover region, which have already been outlined, it is of the highest importance that every step in preparation for the honey-flow be taken in time. This necessitates especial attention to conditions in the fall, for during this period the bees that are to live over winter are reared. It will not do to wait until the clover begins to secrete nectar, or even until spring opens, and then make the most of what the bees are able to do, for this frequently results in a total failure to secure a crop of honey.

OUTLINE OF THE ANNUAL CYCLE FOR THIS REGION.

To have a good colony of bees at the beginning of the active season it is necessary that the beekeeper begin his preparation about August 1 of the previous year. From this time on he should have

constantly in mind the prosperity of the colony for the coming winter period, giving them during the ensuing 6 or 8 weeks conditions favorable for the rearing of bees for the winter colony. During the winter he should in every way assist the bees in conserving their energy, so that they will not begin brood-rearing too early, and so that they may also be able to do the work of brood-rearing to the fullest extent in the spring. During the spring they must be provided with abundant stores or brood-rearing will be curtailed at this critical time. These things will bring the colonies to full or approximately full strength at the time when the clovers begin to bloom. The work from this point on will be largely that incident to the production of the honey-crop, to be discussed in detail further on, but some time previous to the first of August, when another beekeeping year is to begin, the beekeeper should see that every colony has a vigorous young queen.

FALL PREPARATION.

Because of the absence of a late honey-flow in much of this region, brood-rearing is uncertain in late summer and the colonies may have too few young bees for winter. In much of this region brood-rearing normally ceases about the 1st of October, and during the period of 6 or 8 weeks previous to this date are reared the bees which live through the winter. If brood-rearing is not adequate during this time the old bees can not be expected to live until spring. Only those bees which are reared in late summer are able to rear brood sufficient for a full colony the following spring. Brood-rearing naturally decreases in late summer and it is necessary that favorable conditions for brood-rearing be provided or the bees may almost cease brood-rearing and thus endanger the very life of the colony. In the absence of a fall honey-flow this danger is acute.

In addition to seeing that each colony has a vigorous queen previous to August 1, the most important requirement is the leaving of abundant stores for the bees during this critical brood-rearing period. This is more necessary in the clover region than in many other places in the country, and it is an especially important consideration in apiaries where extracted honey is produced, as in this case the brood-chamber is usually short of adequate stores.

If the bees are to be wintered outside, the best plan is to leave with each colony a second hive-body and plan to winter it in the two hive-bodies, as will be discussed later. The upper hive-body should be practically full of honey, and this will usually be the case if this food chamber has been on the hive all summer. This provides a sufficient amount of stores, not only for fall and winter, but also for the period of the spring brood-rearing when the bees must have large quantities of honey.

If the bees are to be wintered in the cellar, as in the far north, it is often not convenient to winter them in two-hive bodies, but in this event the beekeeper must save this amount of honey to be given to the bees as soon as needed in the spring if a full colony is to be reared in time for clover.

When comb-honey is produced the beekeeper should have for each colony a second hive-body to be used as here indicated. Too many comb-honey producers fail to have this, and as a result their bees are often not ready for the clover honey-flow.

The requirements of the colonies for late summer are, therefore, a young queen and two stories for each hive, the upper one practically full of honey. Nothing else that the beekeeper may do at this time will materially contribute to the welfare of the colony.

WINTER CARE.

Because the honey-flow in the clover region comes so soon after the beginning of brood-rearing in the spring, wintering is the most important problem confronting the beekeeper. Throughout the region the winters are severe, making necessary considerable protection of the colonies. In most seasons the bees are confined to the hives without opportunity for flight for a considerable period, sometimes as much as 20 weeks. Bees must have stores of high

FIG. 4.—Map showing average date of first killing frost in fall. From these data the beekeeper determines the time to pack colonies outdoors. Feeding for the improvement in winter stores is done after the first killing frost.

quality during such confinement or they will suffer from dysentery. It is especially important that the honey immediately adjacent to the cluster be good, since this is the part used in the winter. If in the fall the beekeeper finds that these stores are of poor quality, he can correct this by feeding each colony about 10 pounds of either a heavy sugar sirup or honey of fine quality, after brood rearing has ceased. (Fig. 4.) This feeding should be done rapidly. It is not so important that the stores used in the spring be of such good quality, as there are usually opportunities for flight.

In the colder parts of the clover region, where the average winter temperature is below 25° F., many beekeepers prefer to winter their bees in cellars. If this is done, the keeper should see that the cellar is properly constructed, so as to maintain during the period of confinement a uniform temperature, not too low or too high. This usually can best be done by constructing the cellar so that the

ceiling is below the frost line (fig. 5), in order that the cellar may not undergo rapid changes in temperature. Detailed directions for the construction and maintenance of the winter cellar are given in Farmers' Bulletin 1014, to which the reader is referred. When bees are wintered in the cellar they will perhaps be kept in one hive body, but in this event a second hive body with plenty of honey should be stored, to be given to each colony during the period of heavy brood rearing of spring. The hive body with the bees should contain about 25 pounds of honey. A failure to provide this extra room and stores is the cause of great loss in many parts of the clover region. There is no better place to store the extra hive body containing honey, or any better way to winter bees in the cellar, than to leave all the honey with the bees, if one can arrange to handle the heavy hives as they are put into and removed from the cellar.

Outdoor wintering is preferable in the southern part of the clover region. For detailed methods of this work the reader is referred to Farmers' Bulletin 1012. The quadruple packing case (fig. 6), de-

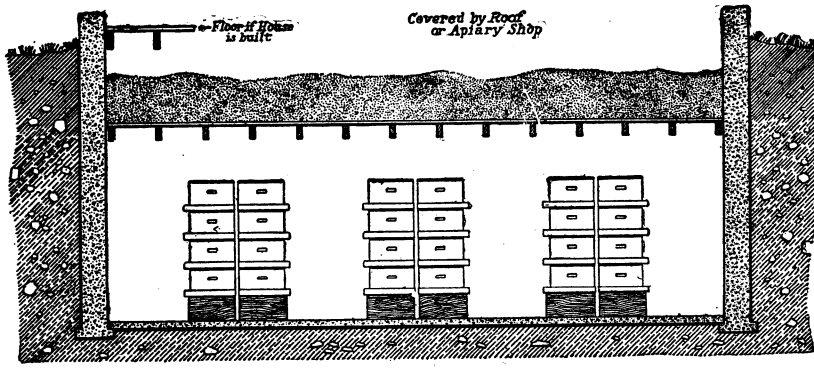

FIG. 5.—Diagram of bee cellar. Clearance 6½ feet, ceiling 2½ feet below ground level, packed with about 1½ feet of sawdust.

scribed in this bulletin, is one of the best for this region. The time for packing (fig. 4) and unpacking the bees and the amount of packing material necessary for good results vary considerably throughout the region, definite directions being found in the bulletin just referred to. Early packing is important in conserving the vitality of the bees that are to start the work of brood rearing the following spring. It is especially necessary that the hives be protected from wind and that the entrances to the packed hives be reduced during cold weather as described in the bulletin on outdoor wintering.

The bees should be wintered in two hive bodies, just as described for the late summer (p. 12). It is not safe in this region to put bees into winter quarters outdoors on less than 45 pounds of stores, for while considerable nectar may come in during the early spring, occasionally this does not happen in this region, and it is necessary that the beekeeper leave the amount specified in order to insure the proper building up of the colony after March 1. It is much safer to leave the entire amount all winter than it is to give more before the time of unpacking in May.

SPRING CARE.

If the bees have been wintered in a cellar in single hive bodies, as is customary, they should be given the second hive body containing the additional honey not more than four weeks after their removal from the cellar. If the lower hive body has scant stores the supply of honey should be given as soon as they are put out of the cellar. Unless stores are needed the cover should not be removed until the second hive-body is added, since the bees will not at this time be able to seal the cover of the hive. Entrances should be contracted on removal from the cellar, and no further spring manipulation is needed or desirable until about the beginning of the clover honey-flow. If it is thought necessary to examine any of the colonies, this should be done from below, but if the proper care has been given

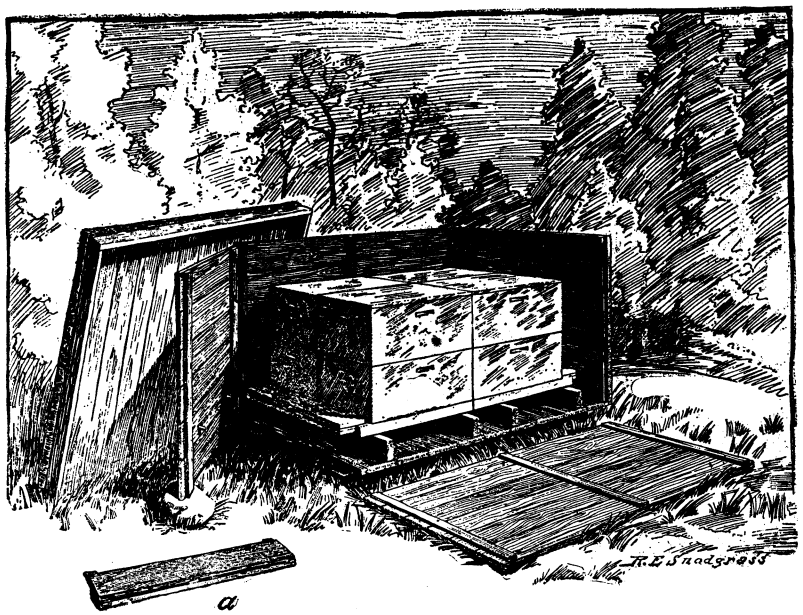

FIG. 6.—The quadruple winter packing case; *a*, detail of tunnel hive. Any type of packing case which gives equivalent insulation on bottom, sides, and top may be used.

the beekeeper knows the condition of each colony without examination, and the bees are better off without disturbance.

If the bees were wintered in packing cases outdoors in two hive-bodies the packing should not be removed until it is necessary to permit some essential spring manipulation. If there is any evidence of preparation for swarming, or if there is an unexpected early spring honey-flow, the bees may need either more room or some different arrangement of the parts of the hive. Ordinarily the only spring manipulation necessary up to the time of unpacking is that of enlarging the entrances to the hives as the population of the colonies seems to require.

Some beekeepers practice the clipping of the wings of their queens in the spring to prevent swarms from leaving, and this is most easily done before the colony population is so greatly increased. If queens

are clipped this should be delayed at least until the time of unpacking outdoor colonies, as the bees need protection until the time specified. With the methods of swarm control applicable in extracted-honey production in the clover region the clipping of queens is superfluous. In comb-honey production it is more important, but is decreasing among the best beekeepers, since swarm control is being more carefully practiced.

In some seasons there may be a tendency for the bees to make preparations for swarming before the usual time of unpacking. When this occurs it is best to unpack all colonies at once and to proceed with swarm-control measures, as increase before or early in the clover honey-flow is undesirable.

ADDITIONAL ROOM FOR HONEY.

In the production of extracted honey the giving of room for surplus honey is not so complicated as in comb-honey production. The honey-flow from the clovers is usually rapid and short, and this makes it necessary that the extra room be given promptly and in sufficient quantity, or some of the honey will be lost. The first super should be given before the honey-flow begins, at the time of unpacking if the bees have been wintered outdoors. Additional supers should be given before the bees are at all crowded for room, usually when the super previously given is about half full and when there is some honey in all of the combs, except that at the close of the honey-flow the bees should be allowed to fill out their supers. Because of the amount of water in nectar from the clovers considerable room is needed for ripening honey, as well as for storage, and a failure to provide this often greatly reduces the crop. Unless honey is to be extracted during the clover honey-flow, as is usually not desirable, the beekeeper of this region will find it desirable to have at least six full-depth hive-bodies for each colony, and sometimes more are needed in good seasons under good management. The measures advised for swarm control influence the arrangement of the supers, as will be described later.

In the production of comb-honey each colony should be reduced to a single hive-body when the first comb-honey super is given, this hive-body being filled with brood. The removed hive-bodies containing some brood should be given to colonies not used for comb-honey production, each colony being given about six such hive-bodies as supers to be filled with honey and later returned after the comb-honey supers have been removed. The first super should contain some bait sections and should be given soon after the appearance of the first white clover blossoms. Additional supers should be added as needed, each being given about the time that the one previously given is about half full, and each should be placed immediately above the brood-chamber, except toward the close of the season. For detailed directions regarding the placing of comb-honey supers the reader is referred to Farmers' Bulletin 1039. The comb-honey producer of this region will find it desirable to have six or seven supers prepared for each colony previous to the honey-flow, for this many will be needed under good management in good seasons.

SWARM CONTROL IN EXTRACTED-HONEY PRODUCTION.

Before the beginning of the honey-flow there will be brood in both hive-bodies, unless the queen has been prevented from going from the second to the first hive-body by imperfections of the combs. As soon as additional hive-bodies are given the queen will almost invariably desert the lower hive-body. After the brood in the lower hive-body has all been sealed, but before any colonies have swarmed, the queen in each colony is placed in the lowest hive-body and a queen excluder placed above it (fig. 7). This may be done either by finding the queen or by shaking the bees together with the queen from the brood-combs into the lower hive-body. Immediately above the queen-excluder are placed whatever supers are needed at that time and above these are

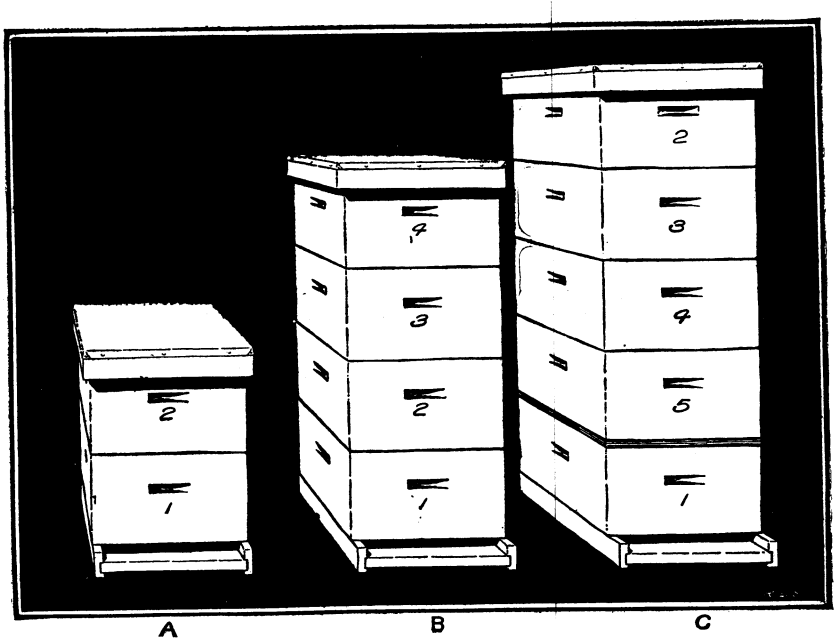

FIG. 7.—Diagram of the swarm-control method for extracted-honey production. *A*, Brood in both hive-bodies in the spring. *B*, Supers 3 and 4 are added as more room is needed, queen usually abandoning lower brood-chamber. *C*, Queen placed below queen-excluder in (1) after all brood in this hive-body is sealed. Empty super (5) is added and brood-chamber (2) is placed on top.

placed the hive-bodies containing brood. Ten days later it may be necessary to remove the queencells from the brood on top of the hives, although this is not always necessary even if queens are reared so far above the new brood-chamber. The hive-body which was formerly the second story will contain 10 frames, and not eight as in the supers, and this is the hive-body which should be left with the bees after the removal of the supers.

If the season is such that swarming is bad, it may be necessary to repeat this operation 10 days or two weeks after the first treatment, this time by shaking the queen and bees of the brood-chamber into a hive-body containing empty combs and placing the brood again on top. Toward the end of the honey-flow the removed brood

may be used for making increase, the brood being removed from the hive at the end of a week after the second treatment for swarming.

SWARM CONTROL IN COMB-HONEY PRODUCTION.

In the production of comb honey the control of swarming is more difficult than when extracted honey is produced. In this case also there will normally be brood in both hive-bodies, and, as has been stated, most of the brood should be placed in the hive-body that is left with the colony when the supers are put on. Strong colonies so reduced should be given two comb-honey supers at once. From this time on until swarming is over it is necessary to examine every untreated colony every seven days to look for queen-cells. If queencells are found which contain only eggs or very young larvæ, all of these queencells should be destroyed, and this will almost always defer swarming until the next examination. To find all the queencells it is necessary to shake most of the bees from the combs, in order that none of the queencells may be overlooked. If on examination queencells are found containing older larvæ, or if the larvæ are unusually well provided with royal jelly, the colony can not be kept from swarming by the removal of queencells and must be treated immediately. The queen and the bees are now shaken from the brood-combs into the same hive, which is now filled with frames of foundation as the old combs are removed. One empty comb should be placed in the center of the new brood-chamber to prevent the colony from deserting. The supers are now replaced. Since the removed brood must have some adhering bees, it is customary to find the queen and then to refrain from shaking two or three of the brood-combs, being sure that the queen is not taken away with the brood. The removed brood is now transferred to another hive, which is placed close beside the original hive. Seven days later, when the bees are flying freely, this hive of brood is removed for increase to a new location, great care being taken to do this gently, so that the bees at work in the field will not find the new location, but will join the original colony. This usually prevents the issuing of an afterswarm and adds the field bees to the producing colony. Since if queencells are shaken the developing queens are often injured, the comb containing the finest of the queencells should be removed without shaking. If no permanent increase is desired, this new colony may be united with the producing colony or elsewhere at the close of the honey-flow.

For other methods of swarm control the reader is referred to Farmers' Bulletin 1198.

REMOVAL OF THE HONEY CROP.

The removal of either extracted honey or comb-honey is greatly facilitated by the use of bee-escapes, especially at the close of the season. If robbing is imminent, care should be taken to keep the honey well covered while it is being taken to the honey-house.

When extracted honey is produced, it should be left on the hives until it is well ripened. The outfit needed for extracting and the methods used will depend on the size of the apiaries maintained. Since this phase of the beekeeper's work has been so adequately dis-

cussed in the current beekeeping literature, and since the needs of each beekeeper will be in some degree unlike those of others, it seems best in this bulletin to lay stress on those phases of the work which are more important, namely, the production of the crop.

When comb-honey is produced, it must be removed as soon as it is finished, and this sometimes necessitates the removal of supers in which there are still unfinished sections. These are assembled in supers and returned to be finished. Previous to shipment to market, comb-honey should be kept in a dry place. Cleaning the sections, grading, and otherwise preparing the sections for market are phases of the work outside the bounds of this bulletin.

PREPARATION FOR LATER HONEY CROP.

When there is reason to expect a honey-flow following that from the clovers, with an interval of dearth between, care must be taken to leave the bees with an abundance of honey, so that brood-rearing may go on with as little interruption as possible. If the fall honey-flow is assured, as is rarely the case, the beekeeper might remove some of the fine-quality clover honey from the hive-body that is to serve as the upper story after the supers are removed. The usual mistake is to leave too little honey at the end of the clover honey-flow.

If the later honey-flow is one which necessitates migratory beekeeping, then the beekeeper is almost compelled to remove the honey so as to move only the bees and empty supers. This is safer because the wise beekeeper does not move his bees unless he is well assured of the value of the new honey-source. Migratory beekeeping is not extensively practiced in the clover region, although there is excellent opportunity for this where there are honey-plants of limited distribution near enough so that they may be reached by a night's run by automobile truck.

In case of a later honey-flow the time of requeening will probably be earlier than is usually best for the clover region. In order that the young queens may have time for the building up of a good colony for a late honey-flow, requeening may be done in connection with swarm control. This procedure will be found discussed in detail in Farmers' Bulletin 1198.

DISEASE CONTROL.

Both American foulbrood and European foulbrood are widely distributed throughout the white-clover region, and the beekeeper must keep their control constantly in mind.

European foulbrood attacks weak colonies, and is prevalent in the spring and early summer, especially among black and hybrid bees. If the beekeeping practices herein recommended are followed carefully, this disease will not cause the beekeeper much anxiety. Its persistence is conclusive proof that his methods are not the best.

American foulbrood can not be prevented or controlled by developing colony strength. It is recommended that any colony in which this disease appears be burned. The bees in diseased colonies should first be killed by slipping into the entrance of the hive a tablespoonful of calcium cyanide on a piece of cardboard or by pouring a cupful or two of gasoline into the hive. The colony should be burned in a hole at least a foot deep. As a hot fire is necessary,

pieces of wood saturated with kerosene should be used for the foundation of the fire. Bees, brood, frames, combs, and honey should be burned. Hive bodies, bottom boards, inner covers, and tops may be removed to a bee-tight building, scraped well to remove all propolis and beeswax, and washed inside and out with a hot soap or lye solution, using a stiff brush.

Diseased colonies should be burned in the evening, when there is little danger of robber bees securing honey from them. Honey from the infected hive must not be spilled, and bees should not be allowed to come in contact with the scrapings or wash water.

Under beekeeping practices as herein outlined European foulbrood will be only a minor trouble, but the beekeeper must keep a constant watch for American foulbrood and dispose of each case as soon as it is discovered. In localities where this disease is present he should inspect all brood nests at least twice a year. The first inspection should be made before June 1.

TIME AND FREQUENCY OF REQUEENING.

There must be no interruption of brood-rearing during the period when bees are being reared for the winter colony, and nothing should be done which will stop egg-laying for even a day during the time between the beginning of brood-rearing in the spring and the beginning of the clover honey-flow. During the spring it is difficult to rear queens. Clearly, then, requeening must be done between the beginning of the clover honey-flow and August 1. The exact time will depend on the method of swarm control employed and on whether there is a honey-flow later than that from the clovers. In most cases the best time to introduce new queens is just in time for them to mate and begin laying early in August. If the beekeeper rears his own queens, as he should if he is heavily engaged in beekeeping, he will usually find it desirable to start his queencells about the middle of July. They may be introduced by means of a cell protector after the removal of the queens about two days before the young queens are ready to emerge. In due time they will emerge, mate, and begin laying eggs, and the interval of no egg-laying at this season will do no harm. For methods of rearing queens the reader must be referred to the books on beekeeping, but it may be stated that this is a branch of the work with which every beekeeper should make himself familiar, since it is not wise to depend on the purchase of all one's queens.

If the methods of beekeeping herein described are followed it will be more necessary to requeen annually than has been the case with the usual practices of beekeepers of the clover region. If extracted honey is being produced, the queens wear out faster than in the average comb-honey apiary. As we go southward in the clover region the necessity of annual requeening is greater than where the seasons are shorter. If there is no regular fall honey-flow, annual requeening to insure the establishment of the winter colony is desirable. If requeening is left to the bees through supersedure, too often it happens that the spring brood-rearing period is broken, resulting in the loss of the crop. Taking all of these things into consideration, annual requeening is advisable throughout most of the clover region, and this practice is increasing.

INCREASE.

In ordinary practice increase in the number of colonies by division before or during the honey-flow from clover results in a decrease in the honey-crop, except when such increase is made from brood which will emerge too late to take part in gathering the crop (pp. 17–18). It is also detrimental to make increase after early August, when bees for winter are being reared. Increase is therefore limited in time just as is requeening.

When permanent increase in the number of colonies is desired, the large colonies may be divided at the time of requeening, thus utilizing the workers that would not live through winter and that will not be serviceable in gathering a honey-crop. No new colony should be started with less than enough bees to care for four or five frames of emerging brood. The brood should be placed chiefly in those colonies which are moved away from the old stand. Queencells should be furnished within two days to all queenless colonies and under no circumstances should the beekeeper allow these small colonies to rear their own queens, as such queens are almost always inferior.

A simple way to make increase at this time, when each colony is to be divided into two, and when the beekeeper has but one apairy, is to remove the lower hive-body containing the queen and brood to a new location. On the old stand is placed a hive containing empty combs, and a queencell is placed between the combs in a cell-protector, the second story being put in place. A hive-body containing full combs of honey is placed on the removed hive containing the queen, for their winter food supply. To prevent the return of too many of the bees of the new colony to their old location, the entrance of the new hive should be closed with green grass. As this dries the bees are released. When out-apiaries are maintained the original hive can be divided into two equal parts, the queenless portion given a queencell, and one part moved to another apiary to prevent its return to the old stand.

MARKET FACILITIES AND METHODS OF MARKETING.

Most of the clover region lies in the part of the United States having the most dense population, and this makes it possible for the beekeeper to sell his honey near the point of production, a thing impossible for beekeepers of many other regions. This at once suggests the desirablility of developing either a local market or one not far away, especially for comb-honey. Beekeepers of this region do this by means of selling from the home to those who call for the honey, by sales to local grocers, or by conducting a mail-order business. Where these plans are not practical, the honey should be so prepared as to enter the general honey markets of the country, in which clover honey brings the highest price.

Because of the possibility of local marketing in the clover region few carlots of this honey reach the general honey markets of the country, but this fact should not be interpreted as indicating a small production in this region, which in reality produces nearly half of the Nation's honey supply.

Semimonthly reports of commercial honey markets may be had free on request from the Chief, Bureau of Agricultural Economics, Department of Agriculture, Washington, D. C.

OPPORTUNITIES FOR DEVELOPMENT OF THIS REGION.

While not all parts of the clover region are equally good, there are few places in which it is not possible to keep bees with profit under proper management. It is unfortunate, however, that the opportunities for beekeeping in this region are not being utilized as completely as in some other beekeeping regions of the country. There are vast areas of the clover region not adequately covered by bees, and also many places where, because of the methods of beekeeping practiced, the beekeepers are failing to produce the best possible crops. Beekeeping to be profitable in this region must be conducted with all possible skill, and there are not sufficient beekeepers with the right amount of skill to cover this territory. A drawback to the adequate development of the clover region lies in the fact that there are thousands of persons owning a few colonies who give their bees little or no attention and who get practically no honey, and these bees serve to occupy territory, while if they were in the hands of a good beekeeper they might be adding to the Nation's honey supply. The spread of the brood diseases is serving to change this condition, for the number of persons owning bees in the clover region is decreasing.

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